CATERPILLAR®

Caterpillar and Oak Ridge National Laboratory: Partnership for Next Generation of Engine and Earth-Moving Equipment

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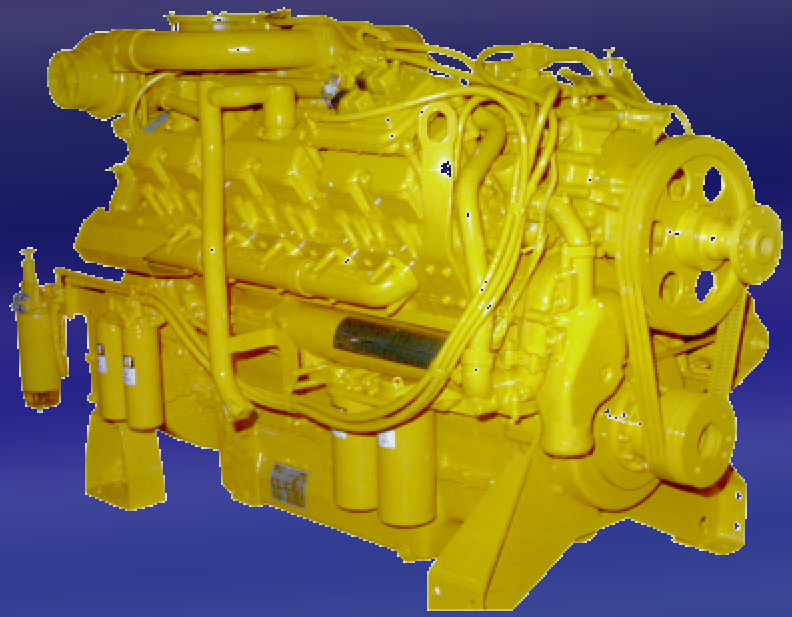
Transportation Manufacturers Showcase, May 6-7, 2002

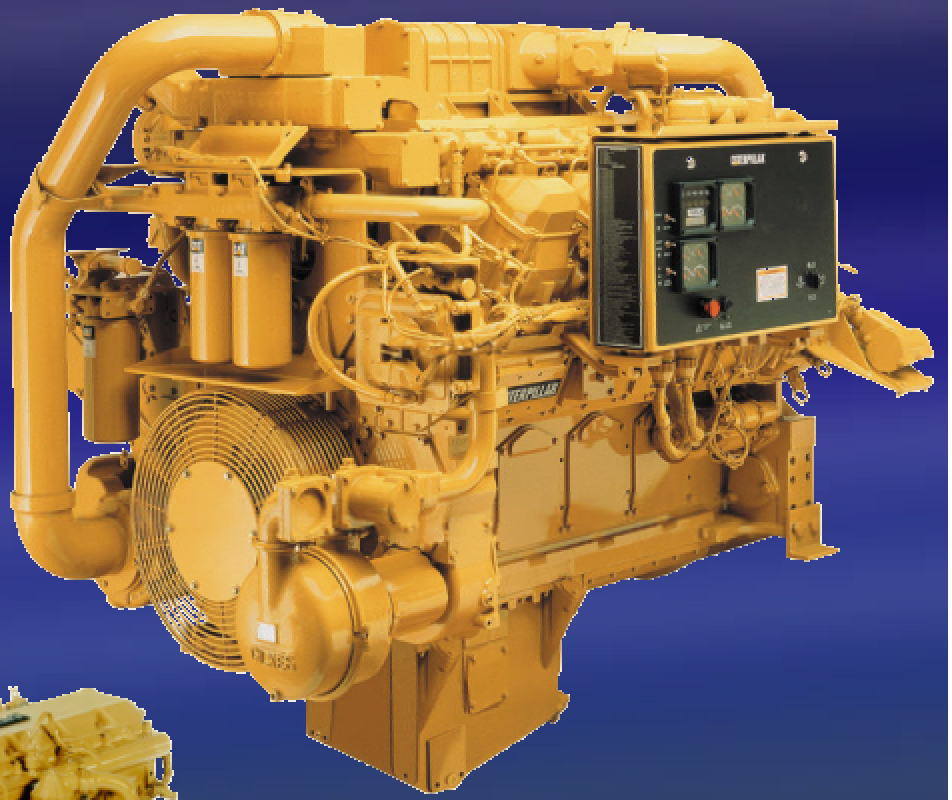
OUTLINE

- The Heavy Equipment Industry
- Opportunities for Improved Materials
- Cooperative Research Efforts
- Partnership for the future

Earthmoving Machines

Engines



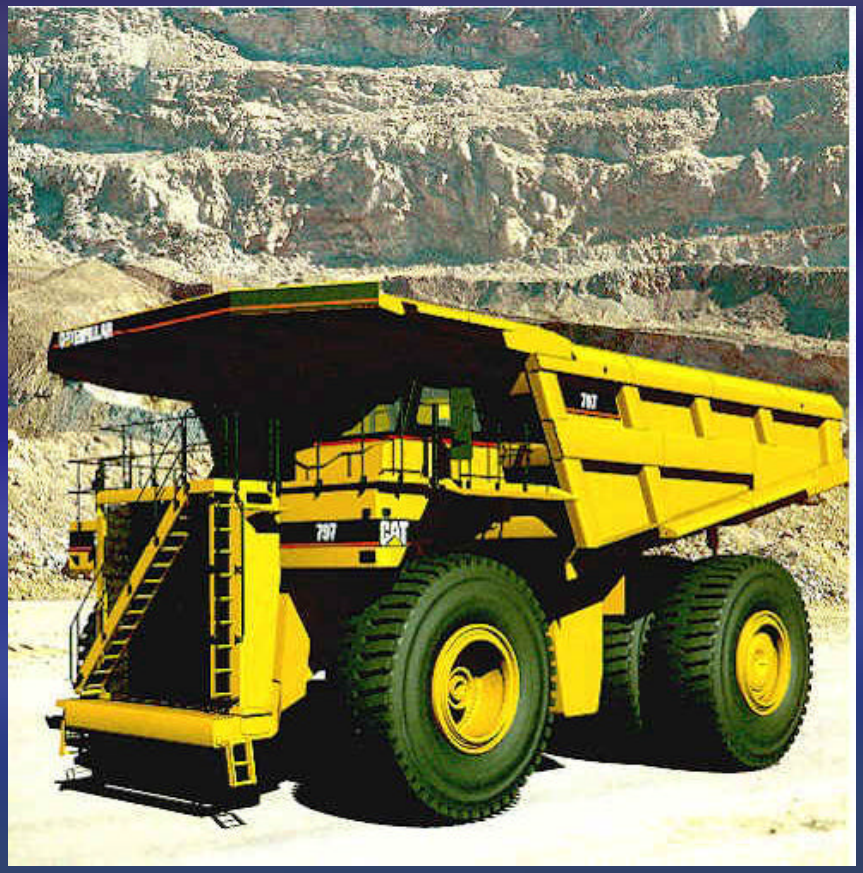


Power Generation

Customer Expectations

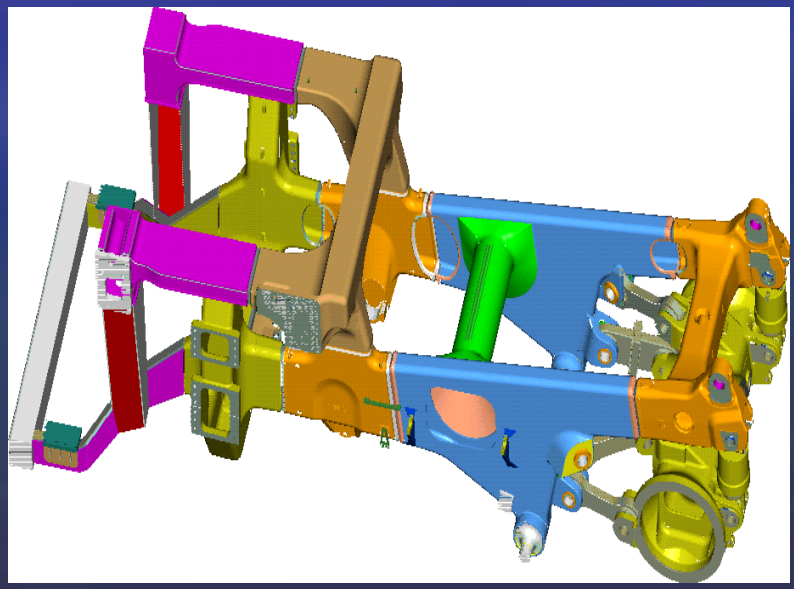
- Durability
- Strength
- Weight
- Life
- Appearance
- Customization

Material Limitations



360 ton truck

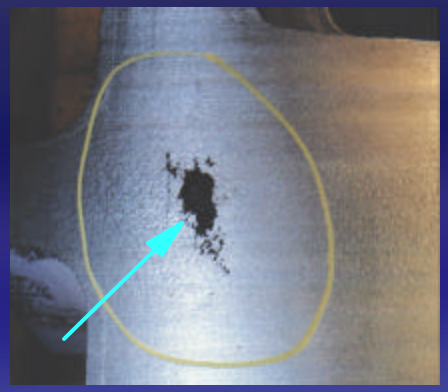
Steel Cast Frame

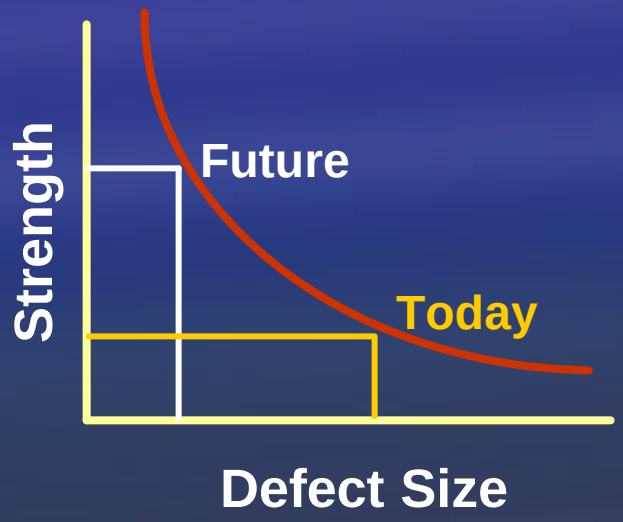


Steel Casting Quality

Higher Reliability

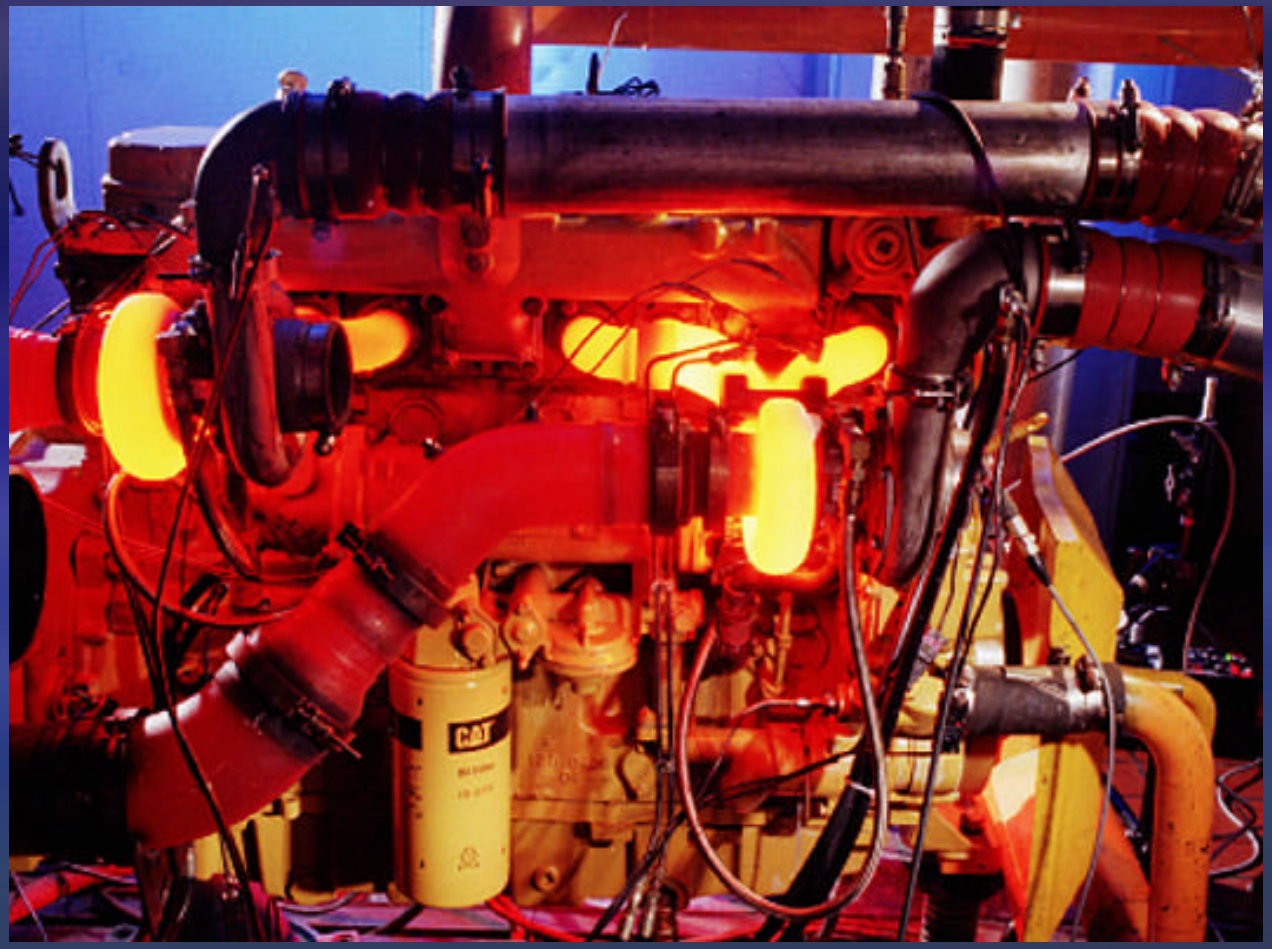
- Smaller defects
- Smaller inclusions
- Chemical homogeneity





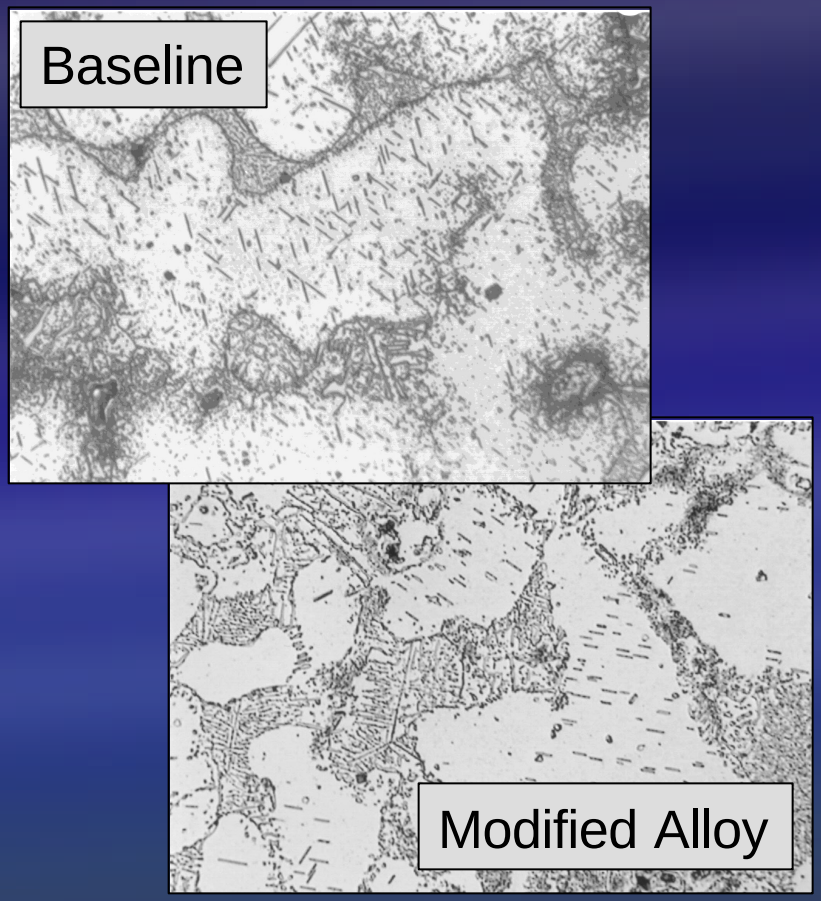
ORNL is developing new simulation tools and casting processes to increase strength and reliability of steel castings.

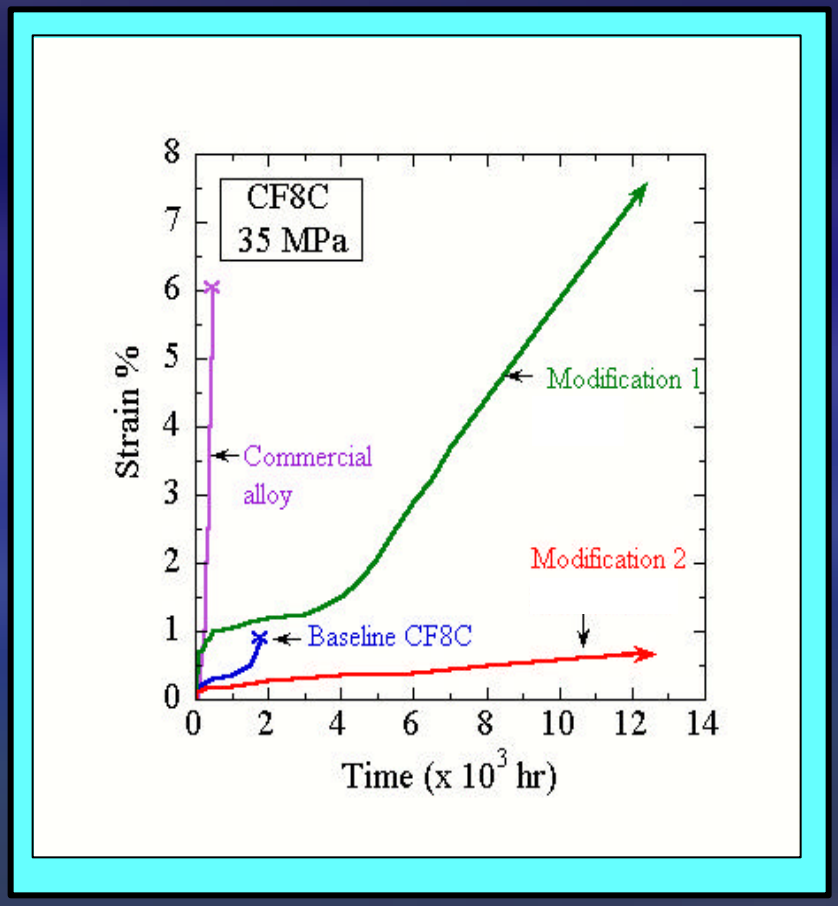
APPLICATIONS FOR NEW ALLOYS



Emission regulations will push engine temperatures higher, requiring greater strength and oxidation resistance.

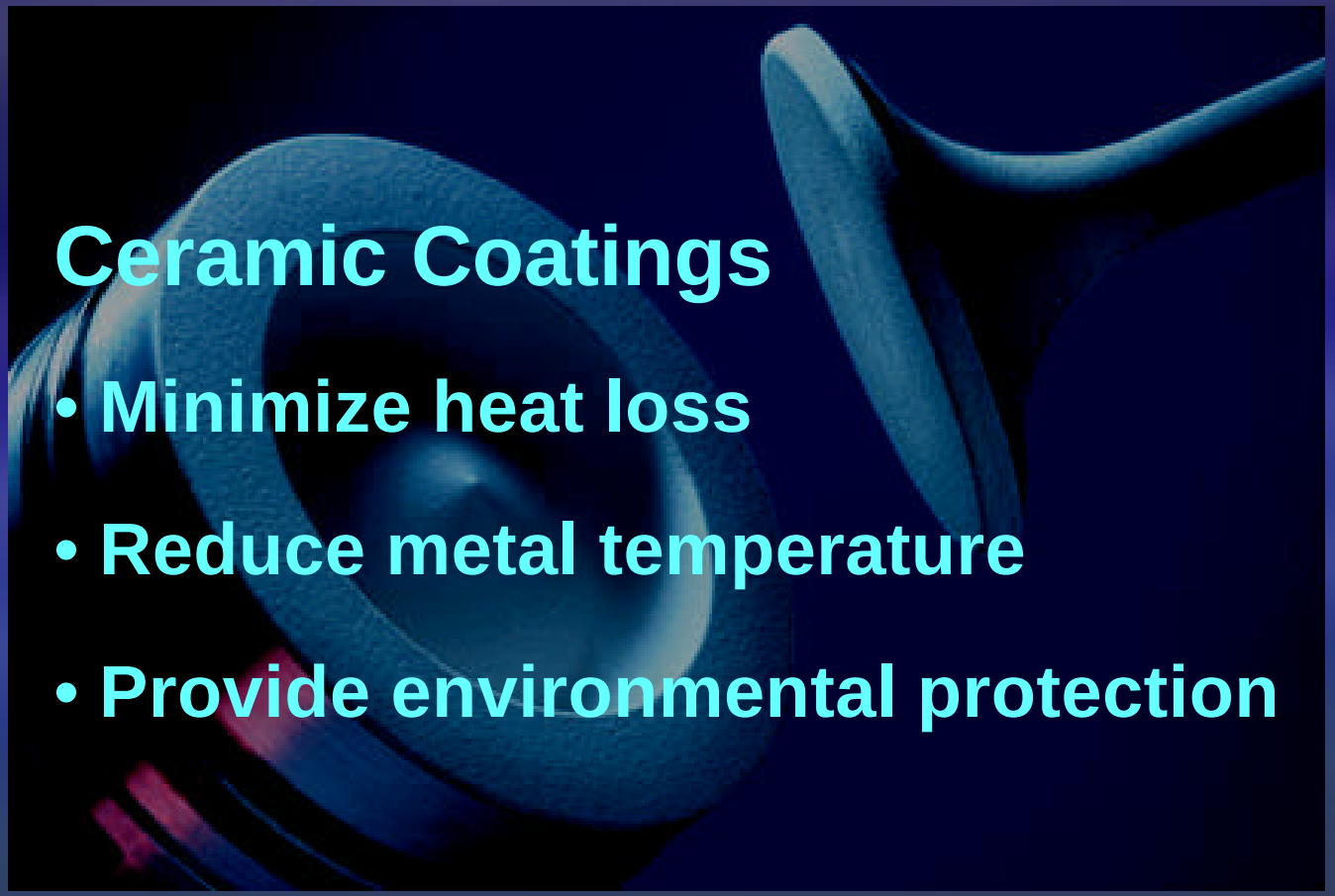
MODIFIED STAINLESS STEEL ALLOYS





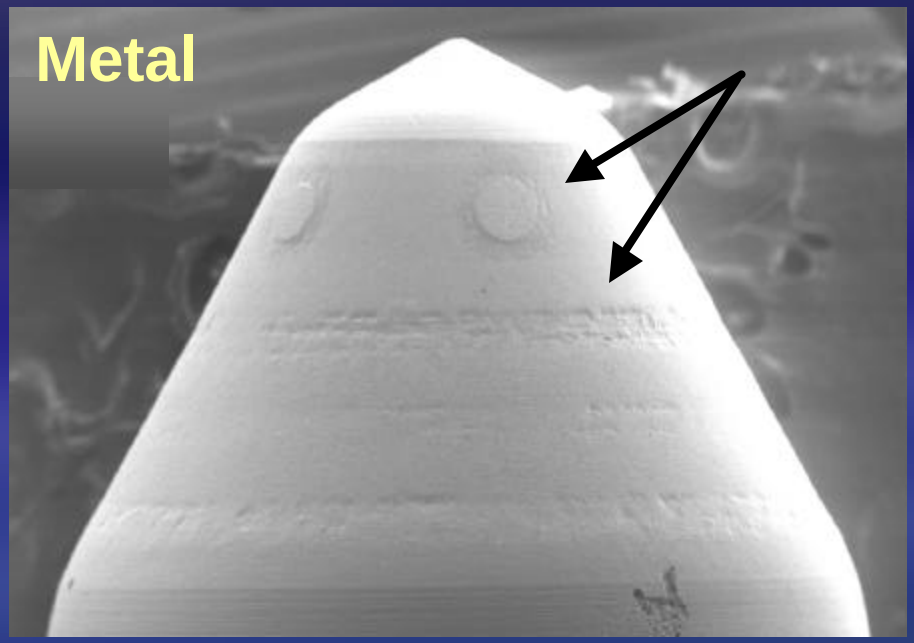
A collaborative R&D project with ORNL researchers resulted in development of a new alloy with 3x strength and 10x fatigue life.

Thermal Barrier Coatings

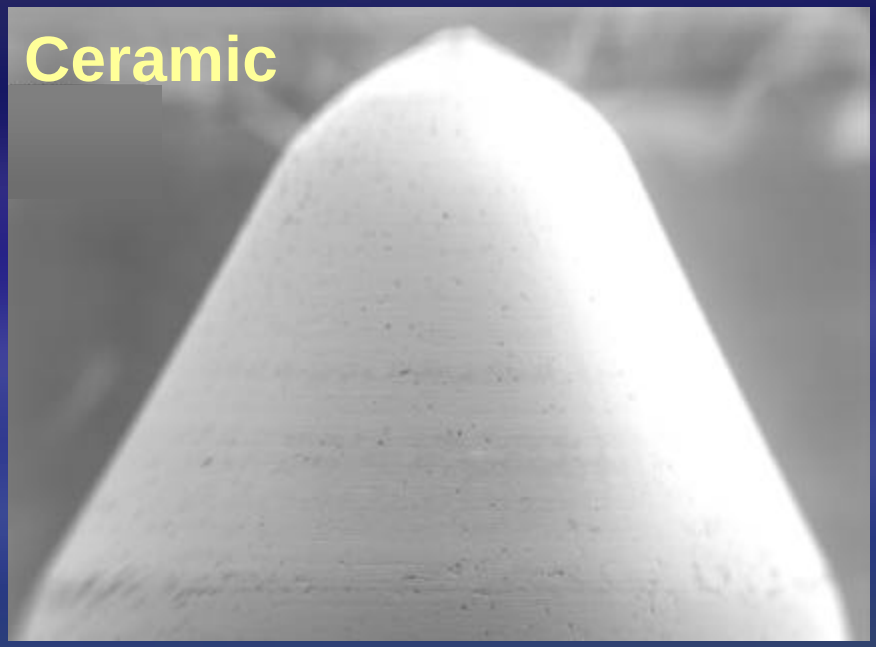


ORNL has developed a new way of bonding coatings to the substrate, greatly enhancing the life of the component.

Ceramics in Wear Applications



Significant Deformation / Wear



No Damage

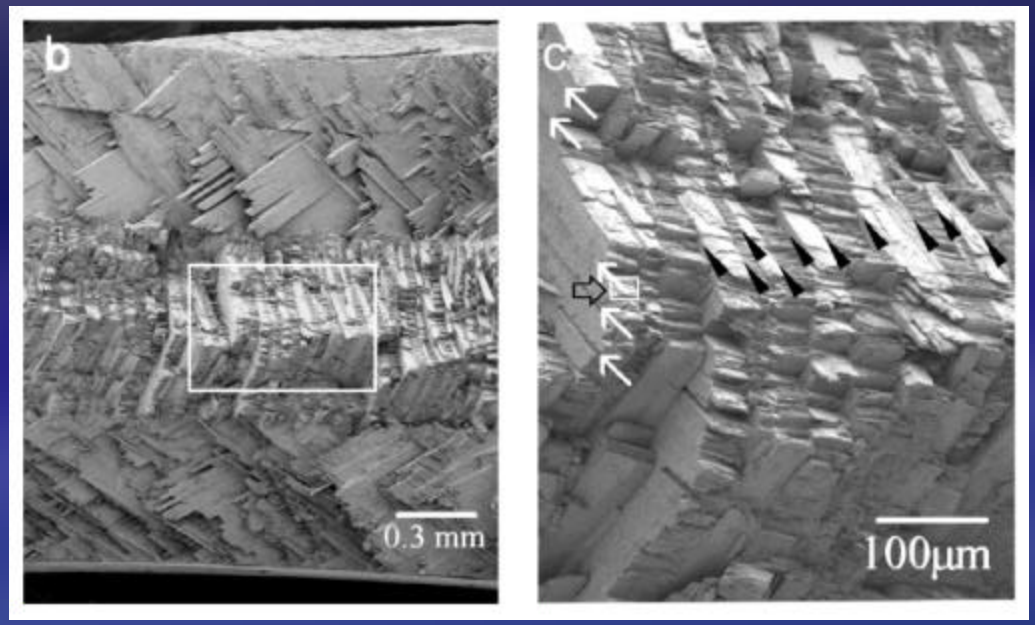
CAT and ORNL developed requisite machining technology to make ceramics more cost effective.

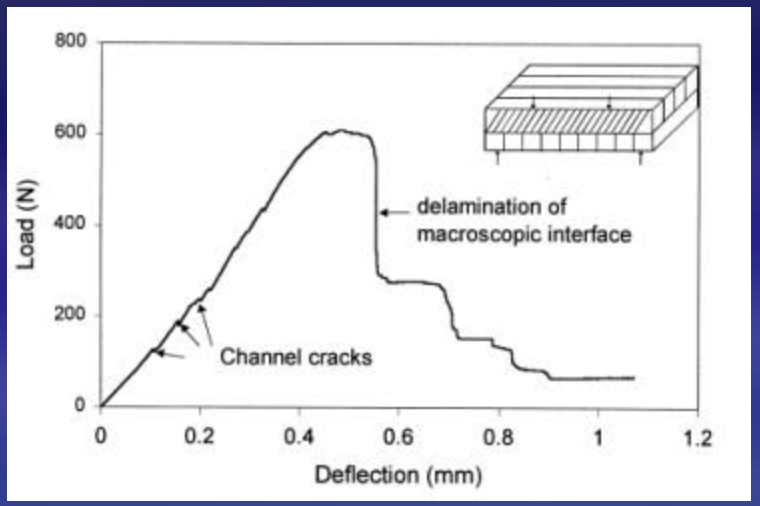
Materials Technology in the Next Decade

Conch Shell - *Strombus gigas*

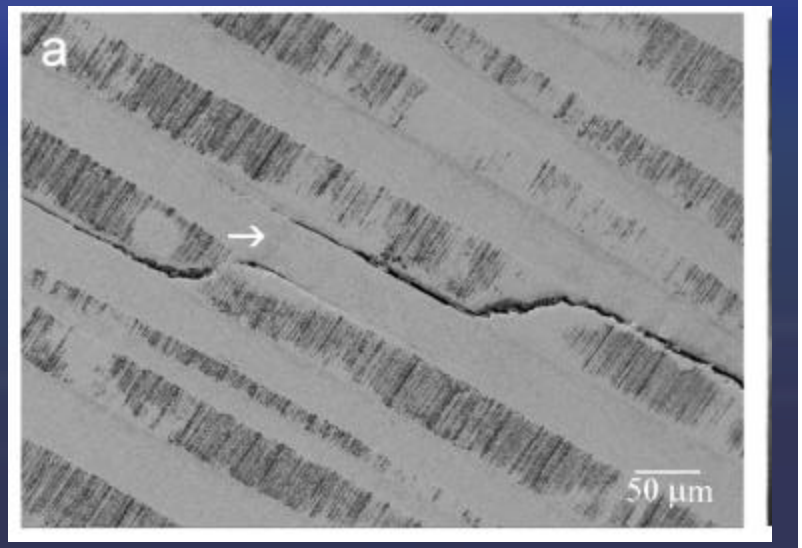
Courtesy A.H. Heuer

Interface Engineering in *Strombus gigas*





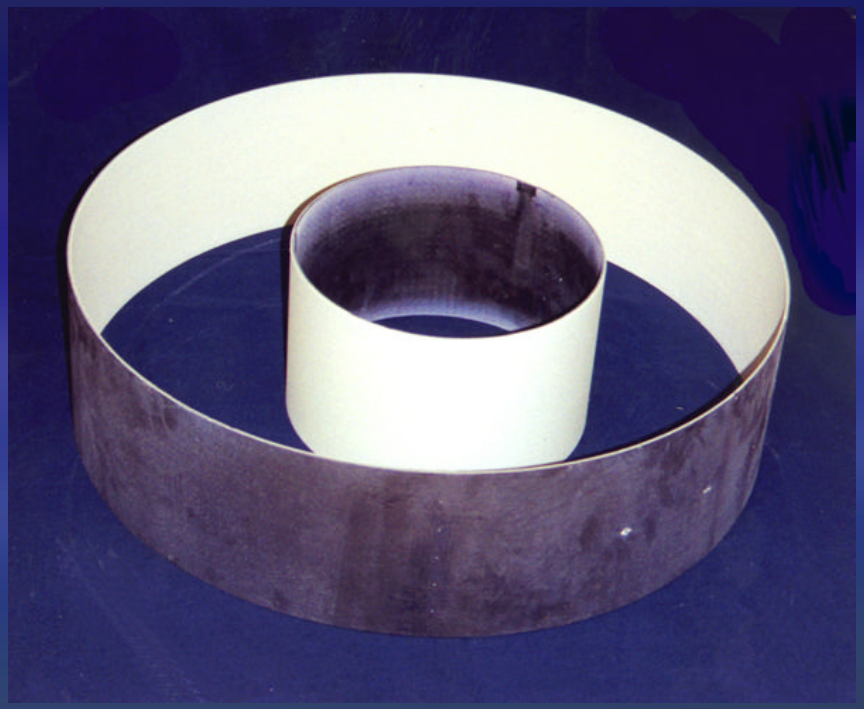
Fracture Surface



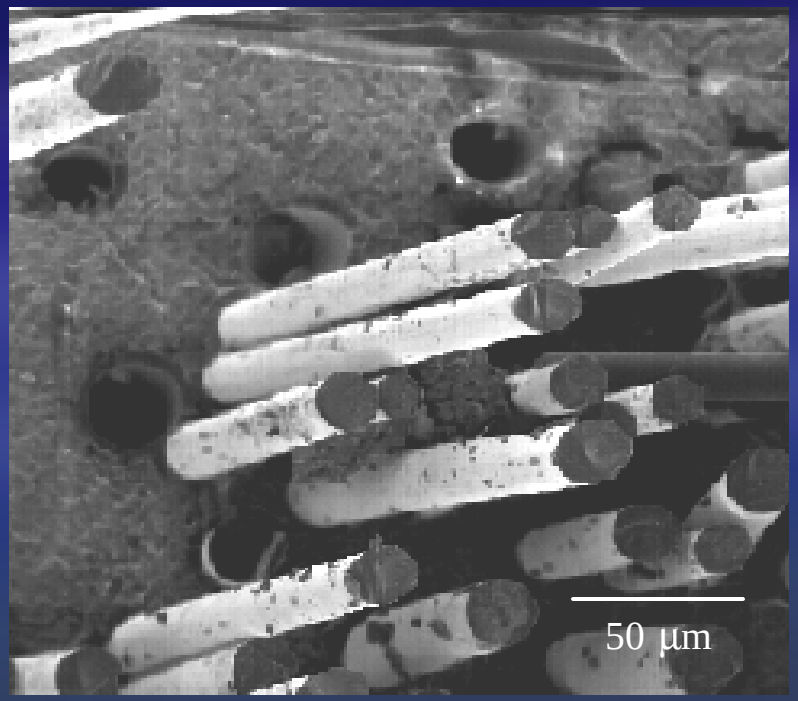
Kamat, Su, Ballarini and Heuer,
Nature [405] June 29, 2000.

Interface Engineering

SiC_f-SiC Composites with EBC



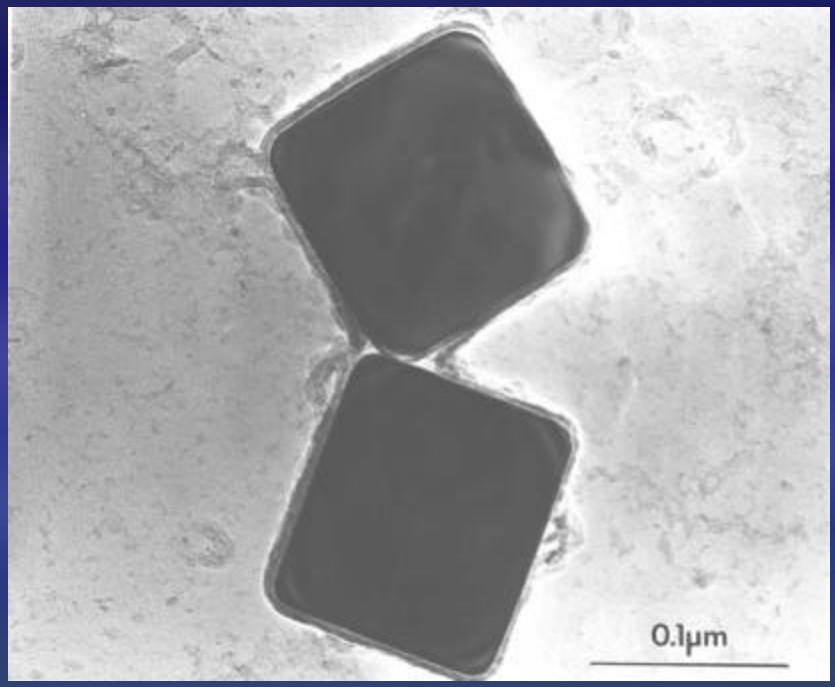
Turbine Combustor Liner



Fracture Surface

ORNL leads the nation in science and characterization of ceramic-composite materials.

Engineering at the Nanoscale



Precipitates in Iron

High-Strength, High-Toughness Steel

Strategic Partnerships

Universities

Suppliers

National Labs

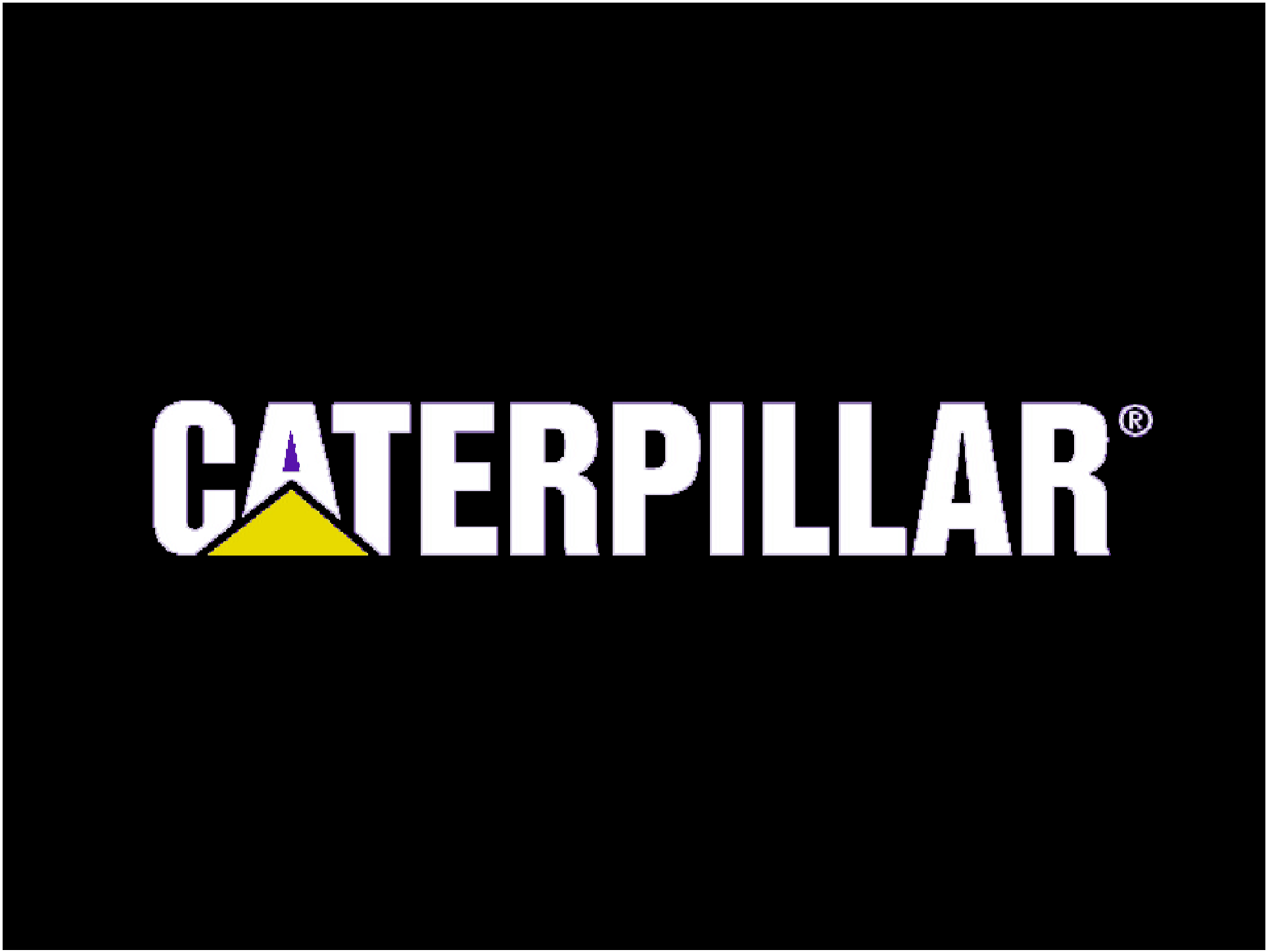
Industries

ORNL has become a vital partner in our quest for better materials technology to support the future of our engines and machines.

R&D in an INDUSTRIAL ENVIRONMENT

"If we allow ourselves the luxury of dispassionate observation, we will see the all-too-imminent chasm facing any corporation that is technically isolated and incapable of harnessing scientific progress because it cannot recognize and apply it."

Dr. Peter R. Bridenbaugh
V.P. Technology, Alcoa
1993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